UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/773,184	02/09/2004	Kia Silverbrook	MTB36US	8429

24011 7590 01/29/2007

SILVERBROOK RESEARCH PTY LTD
393 DARLING STREET
BALMAIN, NSW 2041
AUSTRALIA

EXAMINER	
FIDLER, SHELBY LEE	
ART UNIT	PAPER NUMBER
2861	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/29/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/773,184	SILVERBROOK, KIA	
	Examiner	Art Unit	
	Shelby Fidler	2861	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 October 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-8,10-22,24-27 and 29-54* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-8,10-22,24-27 and 29-54* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *09 February 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *12/7/2006*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

This action is responsive to amendments filed 10/11/2006.

Specification

The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required: the terminology of the heating element being configured such that the energy required to be applied thereto to cause the ejection of a drop is less than the energy required to heat a volume of ejectable liquid equal to the volume of a drop, from a temperature equal to an ambient temperature to the boiling point is not disclosed in the specification.

Appropriate correction is required.

Examiner notes the cancellation of claims 9 and 28, which contained the claim language in question. However, pending claim 45 also contains this claim language; consequently, the objection to the specification remains.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-2, 4-6, 8, 10, 13-15 17, 19-20, 22, 24-25, 27, 29, 32-34, 36-39, 41-44, 46, 49-51, and 53-54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Silverbrook (US 6019457) in view of Kubby (US 5851412) and DeMoor et al.

Regarding claims 1, 17, 19, 36, 38, and 53:

Silverbrook discloses an inkjet printhead (*col. 5, lines 60-61*) and printing system (*Figure 116*) comprising:

a plurality of nozzles (*col. 1, lines 64-65*), each defining a nozzle aperture having a central axis (*Z-axis, col. 2, lines 53-56*);

a bubble forming chamber corresponding to each of the nozzles respectively (*chamber 113, Figure 9*);

at least one heater element disposed in each of the bubble forming chambers respectively (*heater 120, Figure 9*), the heater element configured for thermal contact with a bubble forming liquid (*heater 120 in thermal contact with ink 106, Figure 12*); such that

heating a mass of solid material incorporated in the heater element to a temperature above the boiling point of the bubble forming liquid forms a gas bubble that causes the ejection of a drop of an ejectable liquid through the nozzle corresponding to that heater element (*col. 9, lines 26-28*); and

supplying the nozzle with a replacement volume of the ejectable liquid equivalent to the ejected drop (*col. 12, lines 59-61*); wherein,

the heater element is spaced from the central axis (*Z-axis through nozzle 445, Figure 13*) and defines a current path substantially around the central axis (*col. 9, lines 20-23 with Figure 13*).

Silverbrook does not expressly disclose that the heater element is in the form of a cantilever beam having a supported end and a free end.

However, Kubby discloses a heater element (*suspended portion 18 of heater chip 10; Figs. 1 and 2*) that is in the form of a suspended heater that may be supported by any number of legs (*col. 4, lines 8-10*).

Silverbrook as modified by Kubby do not expressly disclose that the heater element has a mass of less than 10 nanograms that is incorporated into the free end of the heater element.

However, DeMoor et al. disclose a heater element that is less than 2 nanograms (*page 285, Fabrication: Ti thickness = 5nm; TiN thickness = 30nm; heater width = 2000μm; heater width = 0.4μm. Therefore, the volume of Ti within the heater is $4*10^{-12}$ cm^3, and the volume of TiN within the heater is $2.4*10^{-11}$ cm^3. Using the known densities of Ti = 4.54 g/cm^3 and TiN = 5.22 g/cm^3, the heater element has an entire mass of 0.14344 ng*).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize two heater element-supporting legs to make the heater chip in cantilever beam form having a supported end and a free end (Kubby), and to utilize a heater element of less than 10 nanograms (DeMoor et al.) into Silverbrook's invention. The motivation for doing so, as taught by Kubby, is to expose two sides of the heating element to liquid ink so that heat is dissipated into the liquid more efficiently (*col. 2, lines 12-15*). The motivation for doing so, as taught by DeMoor et al., is to provide heaters that show excellent resistivity uniformity and a low TCR value (*page 293, Conclusions*).

Regarding claims 2, 20, and 39:

Silverbrook also discloses that the bubble forming chamber has a circular cross section (*cavity 447, Figure 13*) and the heater element has arcuate sections that are concentric with the circular cross section (*heater elements 441 and 443, Figure 13*).

Regarding claims 4, 22, and 41:

Silverbrook also discloses that the heater elements are ring-shaped (*heater elements 441 and 443, Figure 13*), and that they extend between electrodes mounted on opposite sides of the bubble forming chamber (*connections 442 and 443, Figure 13*).

Regarding claims 5, 24, and 42:

Silverbrook also discloses that the bubble forming liquid and the ejectable liquid are of a common body of liquid (*col. 9, lines 26-30*).

Regarding claims 6, 25, and 43:

Silverbrook also discloses that the printhead is configured to print on a page and to be a page-width printhead (*col. 2, lines 19-22*).

Regarding claims 8, 27, and 44:

Silverbrook also discloses that each heater element is configured such that actuation energy of less than 500 nanojoules is required to be applied to that heater element to heat that heater element sufficiently to form a bubble in the bubble forming liquid thereby to cause the ejection of a drop (*col. 19, lines 8-10*).

Regarding claims 10, 29, and 46:

Silverbrook also discloses that the printhead comprises a substrate having a substrate surface, wherein the areal density of the nozzles relative to the substrate surface exceeds 10,000 nozzles per square centimeter of substrate surface (*using the reference measurement of Figure 43 and counting the individual nozzles disclosed in the "part of cyan" section of Figure 43, calculations show that the density exceeds 10,000 per square cm:* $\frac{20 nozzles}{0.0016384 cm^2} = 12207 \frac{nozzles}{cm^2}$).

Regarding claims 13, 32, and 50:

Silverbrook also discloses that a structure that is formed by chemical vapor deposition, the nozzles being incorporated on the structure (*col. 5, lines 47-49*).

Regarding claims 14, 33, and 49:

Silverbrook also discloses that a structure which is less than 10 microns thick, the nozzles being incorporated on the structure (*col. 9, lines 8-10*).

Regarding claims 15, 34, and 51:

Silverbrook also discloses a plurality of nozzle chambers each corresponding to a respective nozzle (*col. 7, lines 42-44*), a plurality of heater elements being disposed within each chamber (*col. 9, lines 20-23 with heaters 120, Figure 12*); and

Kubby also discloses forming a plurality of heater elements within each chamber, such that the heater elements are formed on different respective layers to one another (*col. 4, lines 48-54, 57-59*).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize within each chamber, a plurality of heater elements on different respective layers into the invention of Silverbrook as modified by Kubby and DeMoor et al. The motivation for doing so, as taught by Kubby, is to provide a backup heating elements in case one of the heater elements within the chamber fails (*col. 5, lines 11-25*).

Regarding claims 18, 37, and 54:

Kubby also discloses that each heater element is covered by a conformal protective coating (*protective tantalum layers; col. 4, lines 35-36*), the coating of each heater element having been applied substantially to all sides of the heater element simultaneously such that the coating is seamless (*Figs. 1 and 3*).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a seamless protective coating to cover the heater element in the invention of Silverbrook as modified by Kubby and DeMoor et al. The motivation for doing so, as taught by Kubby, is to prevent corrosion of semiconductor structures by the liquid ink (col. 4, lines 37-39).

Claims 3, 11, 21, 30, 40, and 47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Silverbrook as modified by Kubby and DeMoor et al., as applied to claims 1, 19, and 38 and 2, 20, and 39 above, and further in view of Moon et al. (US 6761433 B2).

Regarding claims 3, 21, and 40:

Silverbrook as modified by Kubby and DeMoor et al. disclose all claimed limitations except that the heater element is omega-shaped and extends between adjacent electrodes in the side of a bubble forming chamber.

However, Moon et al. disclose a heater element that is omega-shaped (*resistors 104, Figure 5A*) and extends between adjacent electrodes in the side of a bubble forming chamber (*col. 2, lines 34-37 read with electrodes 105, Figure 9*).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize an omega-shaped heater element into the invention of Silverbrook as modified by Kubby and DeMoor et al. The motivation for doing so, as taught by Moon et al., is to provide another embodiment of a resistor that is spaced from the central axis of the nozzle (*col. 6, lines 4-8*) and to produce bubbles that coalesce at the center of the nozzle, thereby preventing satellite droplets (*col. 11, lines 42-46*).

Regarding claims 11, 30, and 47:

Silverbrook as modified by Kubby and DeMoor et al. disclose all claimed limitations except that each heater element has two opposite sides and is configured such that a gas bubble formed by the heater element is formed at both of the sides of the heater element.

However, Moon et al. disclose that each heater element has two opposite sides (*unreferenced elements, illustrated as black blocks, Figures 10-13*) and is configured such that a gas bubble formed by the heater element is formed at both of the sides of the heater element (*Figures 10-13*).

Claims 7, 16, 26, 35, and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Silverbrook as modified by Kubby and DeMoor et al., as applied to claims 1, 19, and 38 above, and further in view of Anagnostopoulos et al. (US 6502925 B2).

Regarding claims 7 and 26:

Silverbrook as modified by Kubby and DeMoor et al. disclose all claimed limitations except that the heater element is predominantly formed from titanium nitride.

However, Anagnostopoulos et al. disclose heater elements predominantly formed from titanium nitride (*col. 10, lines 36-38*).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize titanium nitride heating elements into the invention of Silverbrook as modified by Kubby and DeMoor et al. The motivation for doing so, as taught by Chan (US 5870121), is to take advantage of TiN's highly stable and highly resistive characteristics (*col. 5, lines 11-22*).

Regarding claims 16, 35, and 52:

Anagnostopoulos et al. also disclose each heater element is formed of solid material more than 90% of which, by atomic proportion, is constituted by at least one periodic element, having an atomic number below 50 (*Ti and TiN, col. 10, lines 31-33*).

Claims 12, 31, and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Silverbrook as modified by Kubby and DeMoor et al, as applied to claims 1, 19, and 38 above, and further in view of Campbell et al. (US 4870433).

Regarding claims 12, 31, and 48:

Silverbrook as modified by Kubby and DeMoor et al. disclose all claimed limitations except that the bubble which each element is configured to form is collapsible and has a point of collapse, and wherein each heater element is configured such that the point of collapse of a bubble formed thereby is spaced from that heater element.

However, Campbell et al. discloses a heater element that is configured to form bubbles such that the bubbles are collapsible and have a point of collapse, and wherein each heater element is configured such that the point of collapse of a bubble formed thereby is spaced from that heater element (*col. 3, lines 60-64*).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to use the heater element design of Campbell et al. in the invention of Silverbrook as modified by Kubby and DeMoor et al. The motivation for doing so, as taught by Campbell, is to prevent cavitational damage to the heater elements (*col. 3, lines 14-23*).

Claim 45 is rejected, as best understood, under 35 U.S.C. 103(a) as being unpatentable over Silverbrook as modified by Kubby and DeMoor et al., as applied to claim 38 above, and further in view of Otsuka et al. (US 5485179).

Regarding claim 45:

Silverbrook as modified by Kubby and DeMoor et al. disclose all claimed limitations except that the heater element is configured such that the energy required to be applied thereto to cause the ejection of a drop is less than the energy required to heat a volume of the ejectable liquid equal to the volume of the drop, from a temperature equal to the ambient temperature to the boiling point.

However, Otsuka et al. disclose a heater element that is configured such that the energy required to be applied thereto to cause the ejection of a drop is less than the energy required to heat a volume of the ejectable liquid equal to the volume of the drop, from a temperature equal to the ambient temperature to the boiling point (*col. 13, lines 21-28 shows that the energy required to heat the heater is less when the ambient temperature is high, and more when the ambient temperature is low; therefore, Otsuka teaches that it would take less energy to eject a drop of ink than it would to heat ink from an ambient temperature to a boiling temperature*).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize Otsuka's heating configuration into the invention of Silverbrook as modified by Kubby and DeMoor et al. The motivation for doing so, as taught by Otsuka, is to control the temperature of the recording head based on the present ambient temperature (*col. 12, lines 41-49*).

Response to Arguments

Applicant's arguments with respect to claims 1, 19, and 38 have been considered but are moot in view of the new ground(s) of rejection. Please see the above rejection to Silverbrook in view of Kubby and DeMoor et al., which discloses a heater element in the form of a cantilever beam having a supported end and a free end and that a mass of the solid material is incorporated into the free end.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Communication with the USPTO

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shelby Fidler whose telephone number is (571) 272-8455. The examiner can normally be reached on M-F 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Meier can be reached on (571) 272-2149. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Shelby L. Fidler 1/18/2007

Shelby Fidler
Patent Examiner
AU 2861

STEPHEN MEIER
SUPERVISORY PATENT EXAMINER